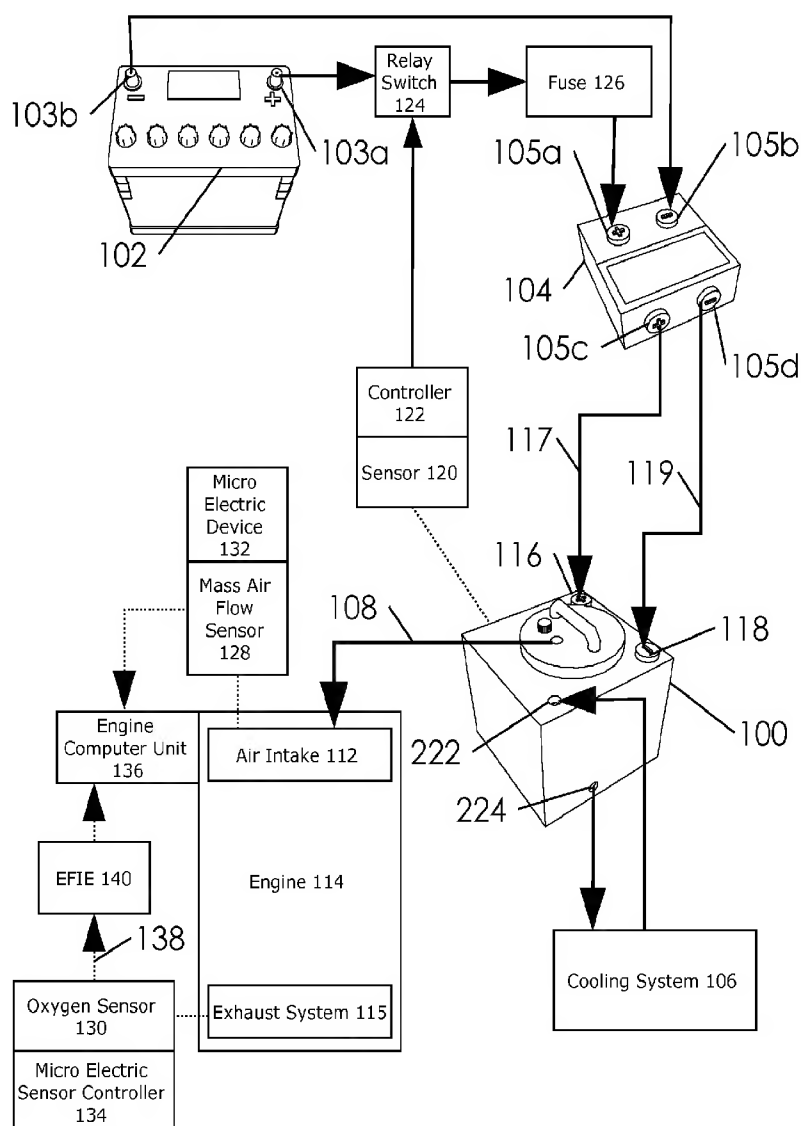




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(19) **United States**(12) **Patent Application Publication****Kramer**(10) **Pub. No.: US 2012/0111734 A1**(43) **Pub. Date: May 10, 2012**(54) **WATER ELECTROLYZER SYSTEM AND METHOD**(52) **U.S. Cl. 205/412; 204/241; 204/228.6**(57) **ABSTRACT**(76) Inventor: **Edward Kramer**, Houston, TX (US)(21) Appl. No.: **13/354,140**(22) Filed: **Jan. 19, 2012****Publication Classification**(51) **Int. Cl.**
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A water electrolyzer comprises a reservoir of water, one or more cells, a source of pulse width modulated direct current electricity, a positive terminal, a negative terminal, and a cooling system. Said electrode cells are submerged in said reservoir of water. Said source of pulse width modulated direct current electricity attaches to said positive terminal and said negative terminal of said water electrolyzer. Said electrode cells each comprise a cathode having a positive terminal and an anode having a negative terminal. Said cathode and said anode comprise different materials. Said positive terminal attaches to said electrode cells with one or more positive lines. Said negative terminal attaches to said electrode cells with one or more negative lines. Said cooling system is capable of cooling said reservoir of water. Said water electrolyzer produces and can deliver one or more gases through a fluid connection with an engine.



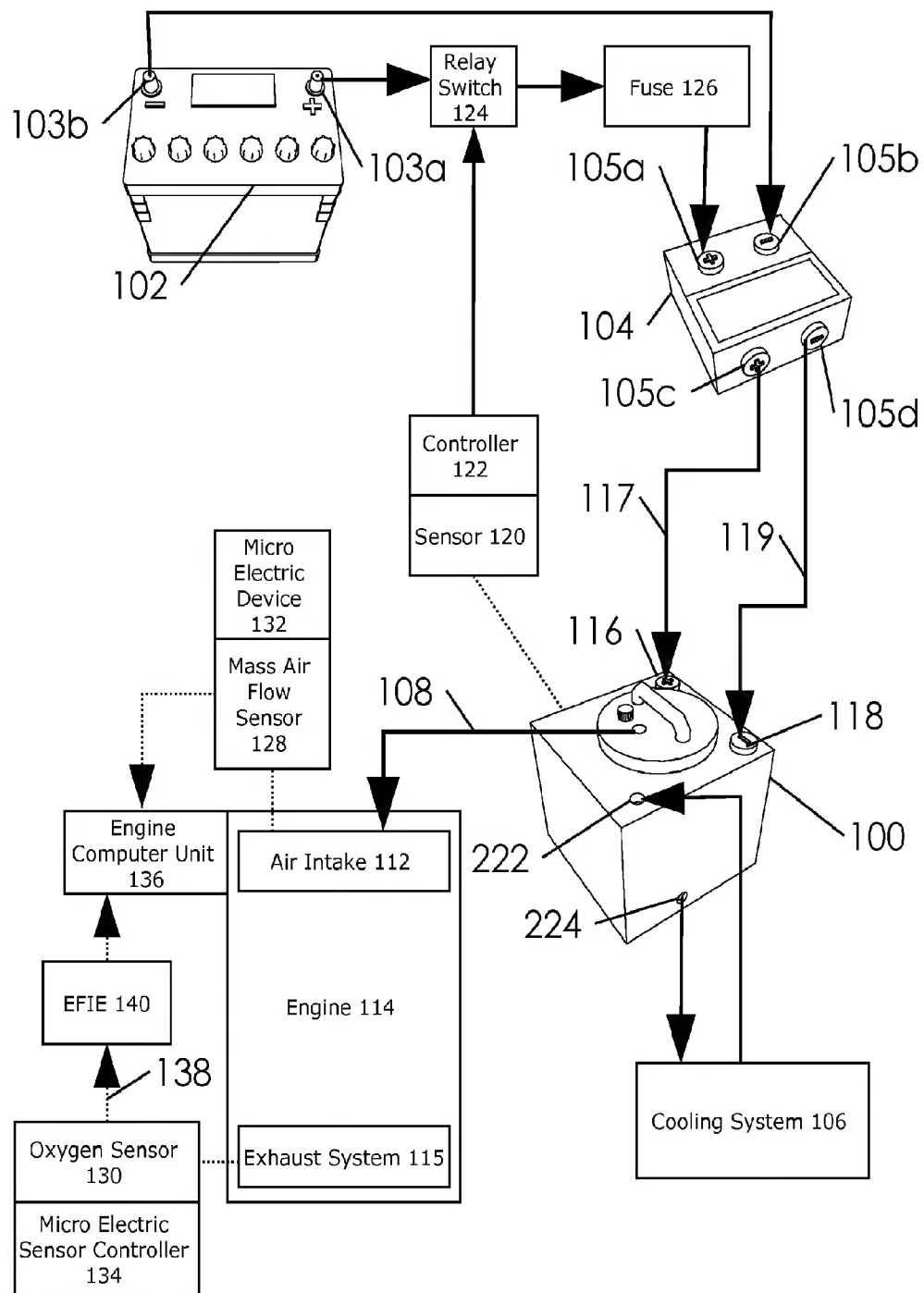


Fig. 1

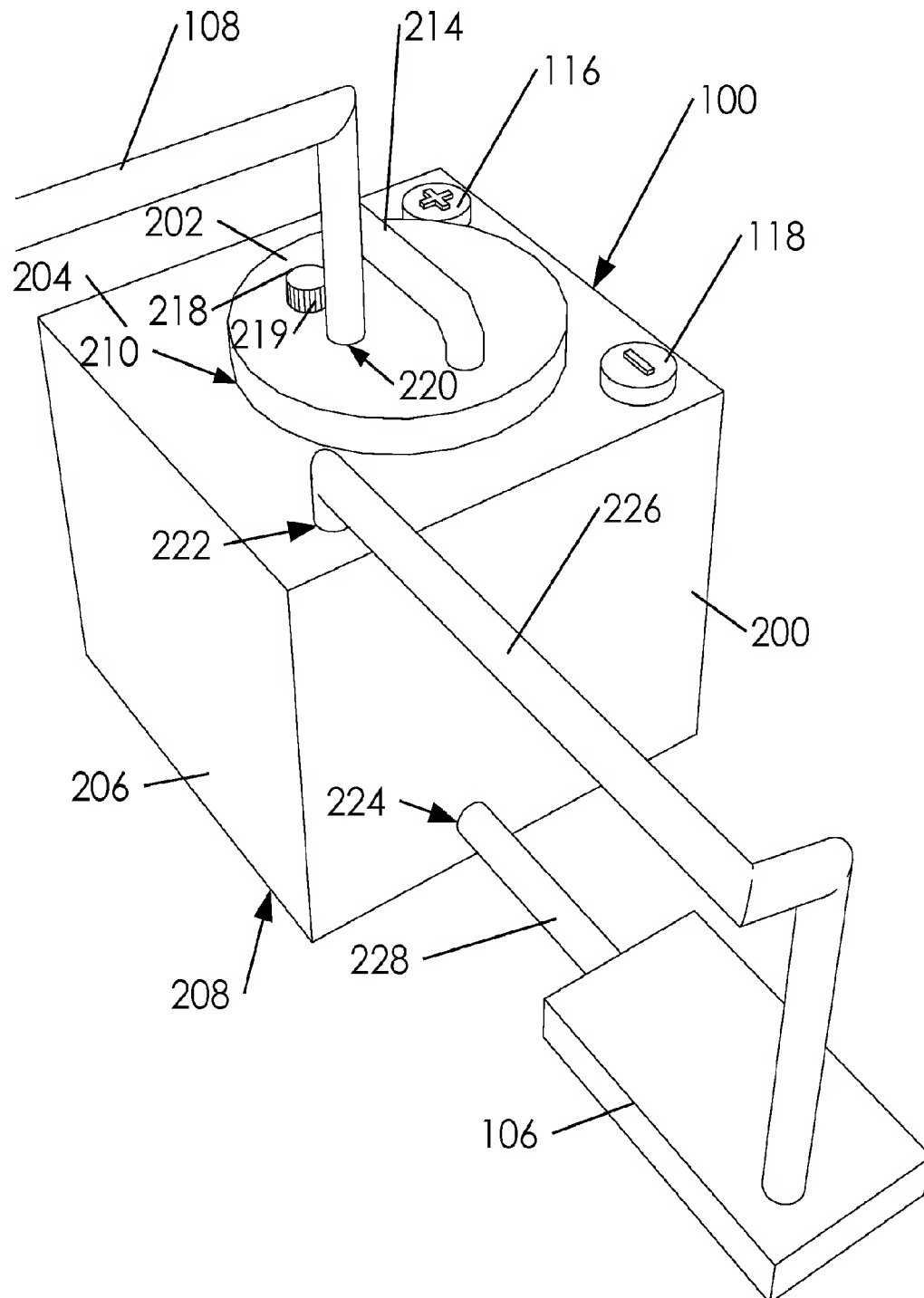


Fig. 2

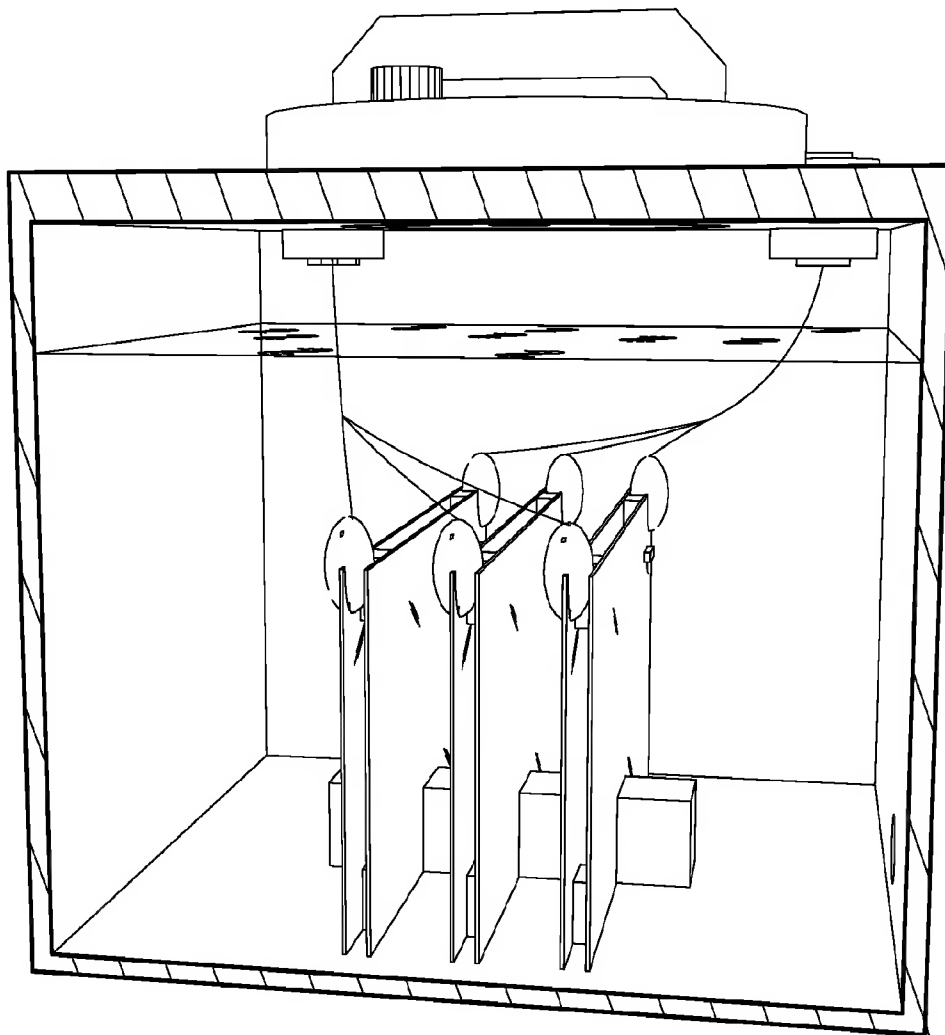


Fig. 3A

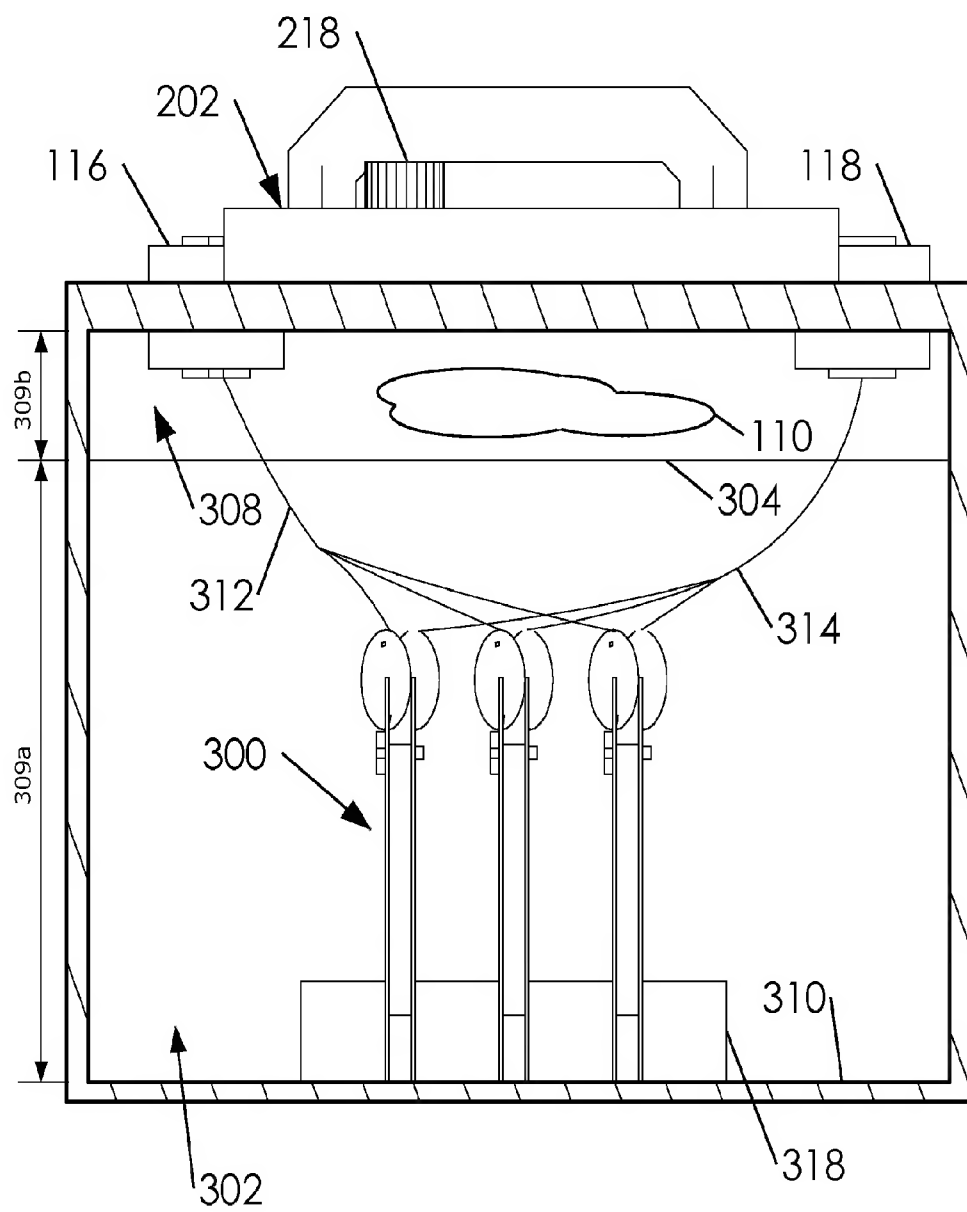


Fig. 3B

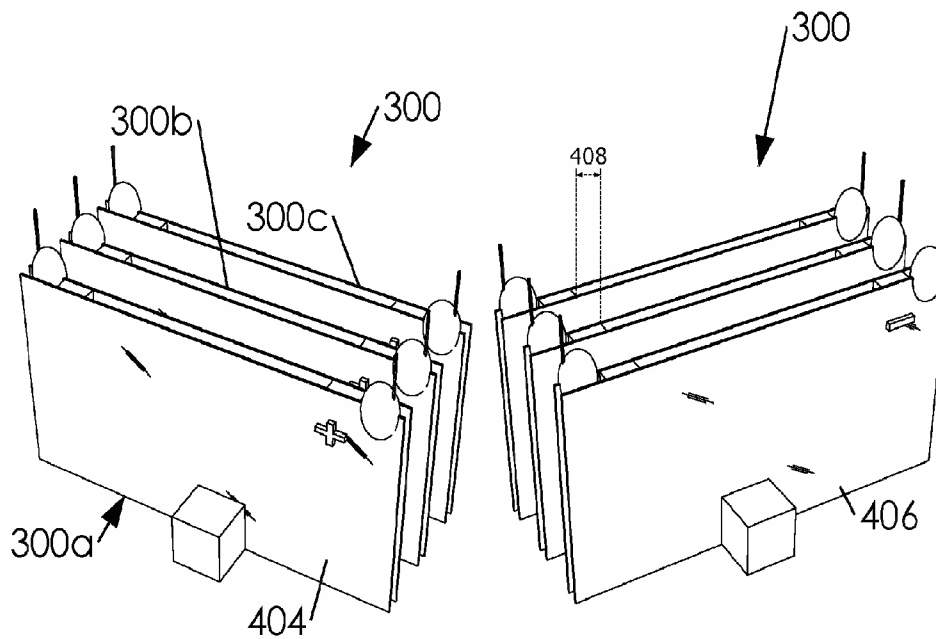


Fig. 4A

Fig. 4B

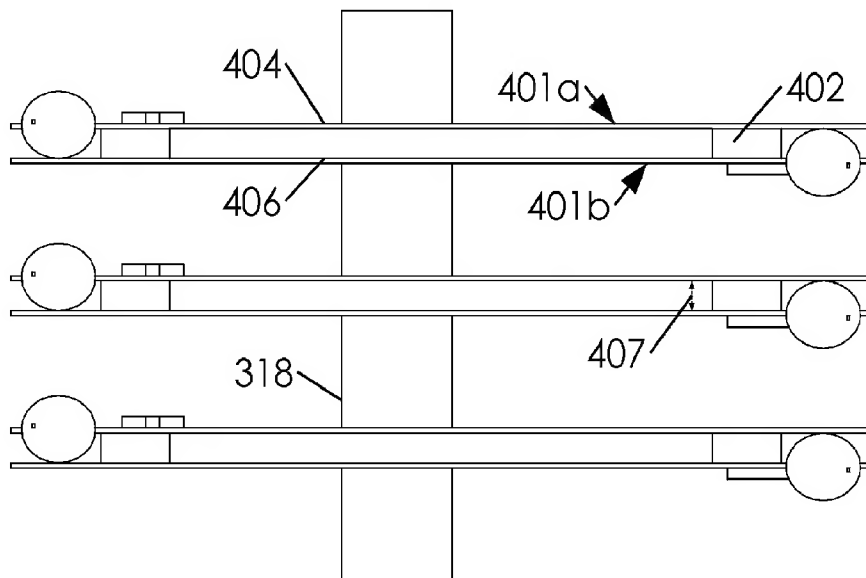


Fig. 4C

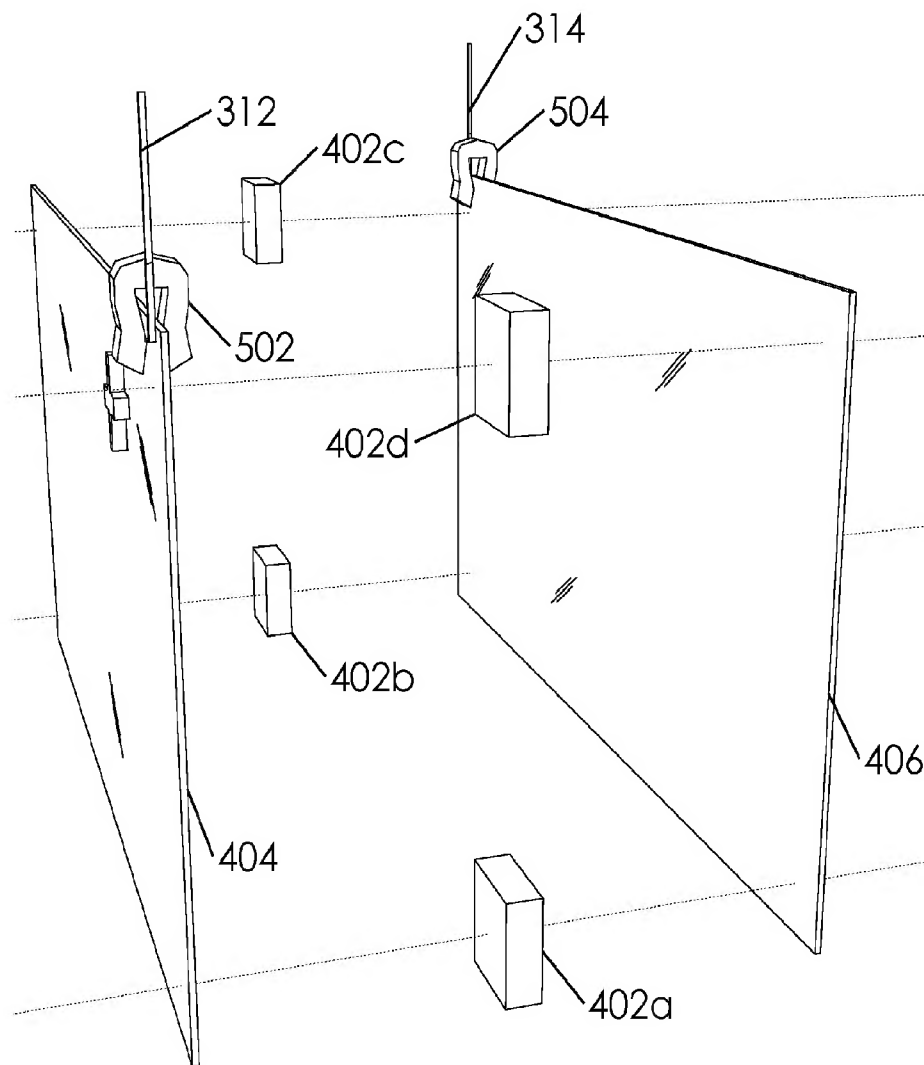


Fig. 5

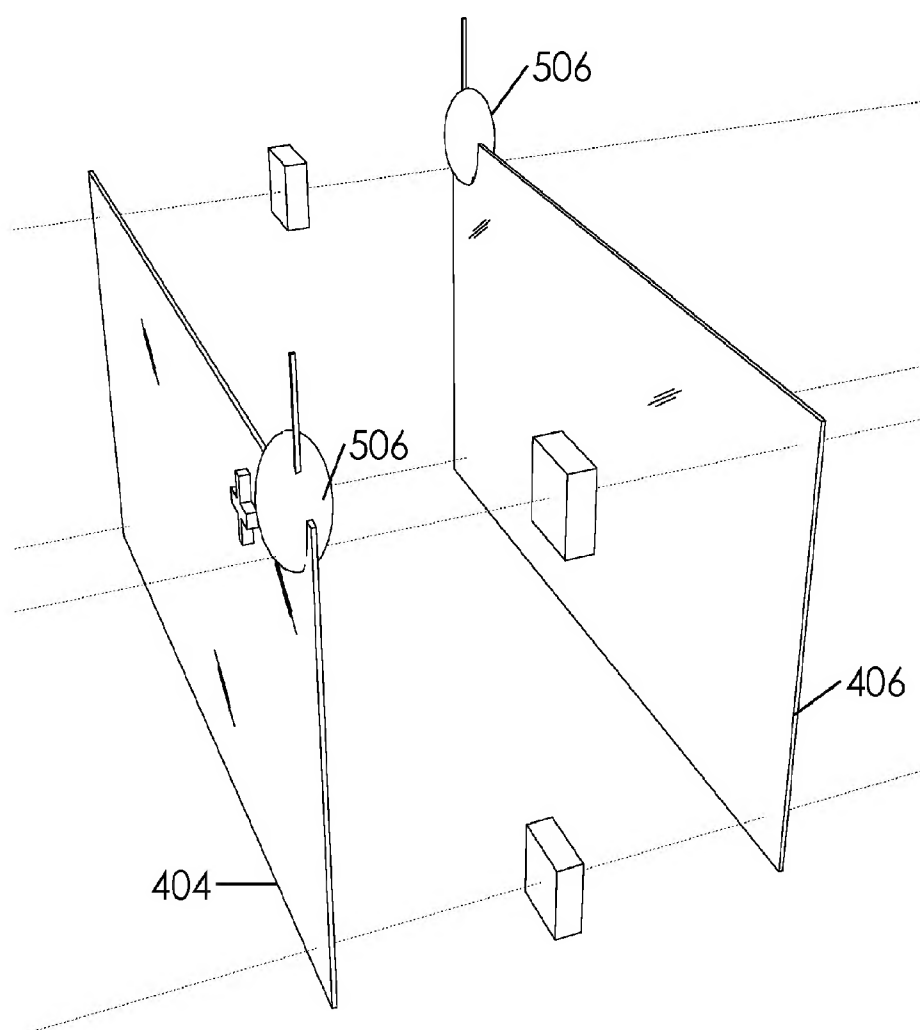


Fig. 5B

WATER ELECTROLYZER SYSTEM AND METHOD

[0001] Applicant hereby states that a basis for special status comprises greenhouse gas reduction as well as other “green technologies” as will be apparent upon reading this application. As is set out infra, Applicant has a working system and method for greenhouse gas reduction with a water electrolyzer by introducing oxyhydrogen into an engine. Accordingly the Applicant hereby petitions for acceptance into the Green Technology Pilot Program.

BACKGROUND

[0002] This disclosure relates generally to a water electrolyzer system and water electrolysis method for internal combustion engines. The term “electrolyzer” refers to an apparatus capable of decomposing a chemical compound by electrolysis. For purposes of this disclosure, said chemical compound undergoing electrolysis will be water. It is understood that generally available water (tap water, bottled water, distilled, or similar) is not strictly H_2O , but a compound comprising a variety of elements in addition to hydrogen and oxygen. Nonetheless, “water” is intended to refer to said generally available water which may or may not be strictly H_2O .

[0003] Water is the most abundant compound on the surface of the earth. The water molecule is comprised of two hydrogen atoms, one oxygen atom and other trace elements of both positive and negative charges. It is the trace elements that provide the capacity of water to be a conductor of electricity. The electrolysis process is frequently utilized for the generation of gases by a decomposition process where electrodes of opposite charge (comprising a negative charged electrode, or “cathode”, and a positive charged electrode, or “anode”) are immersed in an electrically conductive electrolyte with an electrical charge running between the electrodes. In one embodiment, opposite current charge causes the HHO molecule to change its structure where the positive charged hydrogen atom is off-gassed at the negative charged electrode and the negative charged oxygen atom is off-gassed at the positive charged electrode. In one embodiment, elements can recombine to comprise a monoatomic and/or a diatomic hydrogen and/or oxygen compound sometimes called oxyhydrogen (also known as “hydroxyl”). In one embodiment, oxyhydrogen can comprise a mixture of hydrogen (H_2) and oxygen (O_2) gases, typically in a 2:1 molar ratio. In one embodiment, a ratio of 4:1 or 5:1 hydrogen:oxygen is required to avoid an oxidizing flame.

[0004] Water electrolyzer systems for use in internal combustion engines and other industrial processes are well known. Early pioneers used electrolysis to separate and collect the gases for individual use. Mr. Raymond Henes and Mr. William Rhodes (U.S. Pat. No. 3,262,872) (hereafter “Henes”) disclosed the use of a single duct feed system of a mixed atomic hydrogen and oxygen as a fuel source. Henes’ fuel was used as a source for welding/torch applications, but demonstrated use of hydrolysis of water as an energy source.

[0005] Likewise, Mr. Yull Brown (U.S. Pat. No. 4,014,777) further explored the electrolysis process as claimed a new combine gas formed name Brown’s gas. Only later was electrolysis of water explored as a fuel gas. For example, Mr. Stanley A. Meyer (U.S. Pat. Nos. 4,936,961 and 5,293,857), explored the use of pulsating and electric field to liberate the

gases of hydrogen and oxygen from water to be collected as a fuel gas. Meyer refers to a fuel cell water capacitor. Further, Meyer concentrated on an electrical control device to adjust the frequency to facilitate the electrolysis process.

[0006] Naturally, safety of water hydrolysis should be a central concern. Among the prior disclosures, most assume the electrolyzer produces a mixed gas on a safe, reliable consistent process.

[0007] Mr. Bill Ross (U.S. Pat. No. 6,209,493) discloses a system using an electrolysis cell for generating one or more combustible gases from an electrolytic solution. Ross discusses many control devices, but does not disclose the main operating parameters of voltage and current (Amperage). Further, Ross fails to disclose the conductive strength of electrolyte and the effects of current draw from direct current sources. As typical of many prior disclosures, current systems have very little spare amperage capacity. Consequently, overuse of a direct current supply can cause severe electrical systems.

[0008] In one embodiment, it can be advantageous to control a power source coming into a water electrolyzer. Defining workable parameters on said power source is a goal of many prior art examples, but their approaches fall short.

[0009] Mr. Harvath (U.S. Pat. No. 3,954,592) discloses an electrical supply means to apply pulses of electrical energy between an anode and a cathode of one or more cells. Likewise, Mr. John R. Hallenbeck (U.S. Pat. No. 7,762,218) discloses a power source comprising an electrometric net energy radiator having a frequency between 620 Hertz and 100,000 Hertz. Neither Harvath nor Hallenbeck overcome shortcomings regarding materials and cooling issues associated with water electrolysis. As discussed infra.

[0010] Hallenbeck (see supra) discloses a cell with two electrodes, one made of nickel oxide-hydroxide and another formed from a metal selected from the group consisting of nickel, tin, iron, lead, and combinations thereof. Accordingly, cells comprising electrodes of differing materials have been disclosed in the prior art. Nonetheless, Hallenbeck falls short in practice.

[0011] First of all, Hallenbeck does not provide a means of preserving a cathode during water electrolysis. Use of differing materials for said two electrodes does not preserve a cell during electrolysis. Further provisions must be provided to protect said cells and to operate said water electrolyzer in a safe reliable manner, as will be disclosed and claimed infra.

[0012] A side product in many water electrolyzer embodiments is the production of steam. Dealing with this side effect is an important matter.

[0013] Mr. Chou (U.S. Pat. No. 6,740,436) discloses a water cooling system. However Chou’s cooling system requires a source of ice water to function. This approach leaves much to be desired since ice water is cumbersome and difficult to keep replenished in a motor vehicle. Likewise, Mr. Webster (U.S. Pat. No. 4,344,831) discloses a cooling system but does not introduce a means for controlling said cooling system when an electrolyte reaches a heat threshold where a steam (or other side effect) will be produced. Mr. Klein (U.S. Pat. No. 6,866,756) discloses a heat sink means for removing an excess heat generated by the electrolyzer. Said heat sink means leaves much to be desired however. First, it does not respond to heat production within said electrolyzer to the point of cutting off functionality of said electrolyzer when heat gets out of control. Further, it does not sense when steam production conditions have been reached.

[0014] Mr. Huang (U.S. Pat. No. 7,921,831) discloses a heat dissipation unit and one or more filters for separating water vapor. Huang, however, only filters said water vapor it does not prevent it from being produced within said water electrolyzer. Accordingly, Huang allows said water electrolyzer to reach high temperatures without controlling said temperature of said water electrolyzer.

[0015] None of these cooling systems present the advantages disclosed in this application *infra*.

[0016] Construction and methods of use of one or more cells within a water electrolyzer is a critical matter. Much effort has been spent devising a perfect material combination for said water electrolyzers. Typical of many different water electrolyzers, Mr. Mosher (U.S. Pat. No. 4,023,545) discloses a water electrolyzer with electrode cells comprising an anode and a cathode. However, like many water electrolyzers, Mosher does not provide different materials for said anode and said cathode.

[0017] Cells comprising electrodes of different materials are known as well, but do not use advantageous material combinations. Hallenbeck (see *supra*) discloses a cell with two electrodes, one made of nickel oxide-hydroxide and another formed from a metal selected from the group consisting of nickel, tin, iron, lead, and combinations thereof. Mr. Kuchеров (U.S. Pat. No. 5,632,870) discloses an anode and a cathode comprising different materials; wherein, said cathode comprises a material consisting of Ni, Fe, Pd, Pt and Ir. Hallenbeck and Kuchеров, however, fall short in practice since neither provides a means of preserving a cathode during water electrolysis. In practice, these electrodes undergo rapid decay during electrolysis. Further provisions must be provided to protect said cells and to operate said water electrolyzer in a safe reliable manner, as will be disclosed and claimed *infra*.

[0018] Prior disclosures fail to disclose a means of maintaining the integrity of an electrolyzer through a longer period of use. Further, they leave much to be desired in safely operating an electrolyzer in proximity to an internal combustion engine.

[0019] Prior disclosures, when put into practice, have many shortcomings which this disclosure seeks to address. Prior embodiments comprise an electrolysis process which can draw too much current (thereby eliminating efficiency gains), fail to address overheating issues (which can damage engines and electrolyzers alike), and can dissolve electrode materials and wiring (leading to a loss of operation requiring major maintenance).

[0020] Simply put: prior embodiments of water electrolyzers fail to safely and consistently provide fuel gas for internal combustion engines. Therefore, they fail to provide the benefit of reducing exhaust emissions of greenhouse gases and improving efficiency of internal combustion engines over long periods of operation. It is therefore desired to fulfill the promise of electrolysis of water with internal combustion engines.

[0021] None of the above inventions and patents, taken either singularly or in combination, is seen to describe the instant disclosure as claimed. Accordingly, an improved water electrolyzer system and water electrolysis method for internal combustion engines would be advantageous.

SUMMARY

[0022] Two water electrolyzer systems and a water electrolysis method for internal combustion engines are disclosed.

[0023] In one embodiment, said water electrolyzer comprises a casing, a reservoir of water, one or more electrode cells, a source of pulse width modulated direct current electricity, a positive terminal, a negative terminal, and a cooling system. Said casing holds said reservoir of water and said one or more cells. Said electrode cells are submerged in said reservoir of water. Said reservoir of water comprises an electrolyte. Said source of pulse width modulated direct current electricity comprises a positive current and a negative current. Said source of pulse width modulated direct current electricity attaches to said water electrolyzer by attaching said positive current to said positive terminal and said negative current to said negative terminal of said water electrolyzer. Said electrode cells each comprise a cathode and an anode. Said cathode comprises a positive charge. Said cathode comprises a titanium (Ti) metal plate comprising a ruthenium (Ru) coating. Said cathode and said anode are arranged parallel to one another with one or more spacers between them. Said one or more spacers are nonconductive. Said positive terminal of said water electrolyzer attaches to said cathodes of said electrode cells with one or more positive lines. Said negative terminal of said water electrolyzer attaches to said anodes of said electrode cells with one or more negative lines. Said cooling system is capable of cooling said reservoir of water. Said water electrolyzer produces one or more gases. Said water electrolyzer is in fluid connection with an engine. Said water electrolyzer is capable of delivering said gases to said engine, and an inlet and an outlet in said casing. A portion of said reservoir of water is capable of circulating through said cooling system. Said cooling system comprises a circulation pump, heat exchanger and a cooling fan.

[0024] In another embodiment, said water electrolyzer comprises a casing, a reservoir of water, one or more electrode cells, a source of pulse width modulated direct current electricity, a positive terminal, a negative terminal, and a cooling system. Said casing holds said reservoir of water and said one or more cells. Said electrode cells are submerged in said reservoir of water. Said source of pulse width modulated direct current electricity comprises a positive current and a negative current. Said source of pulse width modulated direct current electricity attaches to said water electrolyzer by attaching said positive current to said positive terminal and said negative current to said negative terminal of said water electrolyzer. Said electrode cells each comprise a cathode and an anode. Said cathode and said anode comprise different materials. Said positive terminal of said water electrolyzer attaches to said cathodes of said electrode cells with one or more positive lines. Said negative terminal of said water electrolyzer attaches to said anodes of said electrode cells with one or more negative lines. Said cooling system is capable of cooling said reservoir of water. Said water electrolyzer produces one or more gases. Said water electrolyzer is in fluid connection with an engine, and said water electrolyzer is capable of delivering said gases to said engine.

[0025] Said water electrolysis method comprises submerging one or more electrode cells in a reservoir of water within a water electrolyzer; applying a source of pulse width modulated direct current electricity to said electrode cells; generating one or more gases within said water electrolyzer; attaching said water electrolyzer to an engine with a fluid connection; feeding said gases from said water electrolyzer into said engine; and, regulating a temperature of said reservoir of water with a cooling system. Said water electrolyzer comprises a casing. Said casing comprises an airtight vessel.

Said water electrolyzer comprises a positive terminal and a negative terminal. Said reservoir of water comprises an electrolyte. Said source of pulse width modulated direct current electricity comprises a positive current and a negative current. Said source of pulse width modulated direct current electricity attaches to said water electrolyzer by attaching said positive current to said positive terminal and said negative current to said negative terminal of said water electrolyzer. Said electrode cells each comprise a cathode and an anode. Said positive terminal of said water electrolyzer attaches to said cathodes of said electrode cells with one or more positive lines. Said negative terminal of said water electrolyzer attaches to said anodes of said electrode cells with one or more negative lines. Said cathode and said anode comprise different materials. Said cathode and said anode are held apart by one or more spacers. Said spacers comprise a nonconductive material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] FIG. 1 illustrates a flow diagram of a water electrolyzer system and water electrolysis method for internal combustion engines.

[0027] FIG. 2 illustrates a perspective front overview of water electrolyzer with cooling system.

[0028] FIGS. 3A and 3B illustrate a perspective side cross-section view and an elevated side cross-section view of water electrolyzer showing interior portion and one or more electrode cells.

[0029] FIGS. 4A, 4B and 4C illustrate a perspective front view, perspective rear view and elevated top view of electrode cells.

[0030] FIG. 5A illustrates a perspective exploded side view of one of electrode cells.

[0031] FIG. 5B illustrates a perspective exploded side view of one of electrode cells with an epoxy coating on first clip and second clip.

DETAILED DESCRIPTION OF THE DRAWINGS

[0032] Described herein is a water electrolyzer system and water electrolysis method for internal combustion engines. The following description is presented to enable any person skilled in the art to make and use the invention as claimed and is provided in the context of the particular examples discussed below, variations of which will be readily apparent to those skilled in the art. In the interest of clarity, not all features of an actual implementation are described in this specification. It will be appreciated that in the development of any such actual implementation (as in any development project), design decisions must be made to achieve the designers' specific goals (e.g., compliance with system- and business-related constraints), and that these goals will vary from one implementation to another. It will also be appreciated that such development effort might be complex and time-consuming, but would nevertheless be a routine undertaking for those of ordinary skill in the field of the appropriate art having the benefit of this disclosure. Accordingly, the claims appended hereto are not intended to be limited by the disclosed embodiments, but are to be accorded their widest scope consistent with the principles and features disclosed herein.

[0033] FIG. 1 illustrates a flow diagram of a water electrolyzer system and water electrolysis method for internal combustion

engines can comprise a water electrolyzer 100, a battery 102, a PWM 104, a cooling system 106 and a feed line 108. In one embodiment, water electrolyzer 100 can be capable of decomposing a chemical compound by electrolysis. In one embodiment, said chemical compound undergoing electrolysis will be water. In one embodiment, said water can comprise tap water, bottled water, distilled, deionized water, or similar. The term "water" is not strictly H₂O, but a compound comprising a variety of elements in addition to hydrogen and oxygen. For example, in one embodiment, water molecules can comprise two hydrogen atoms, one oxygen atom and other trace elements of both positive and negative charges.

[0034] In one embodiment, water electrolyzer 100 can produce one or more gases 110 (not illustrated here). In one embodiment, gases 110 can comprise hydrogen (H₂) and oxygen (O₂). In one embodiment, gases 110 can be sent through feed line 108 into an air intake system 112 of an engine 114. In one embodiment, engine 114 can comprise an internal combustion engine (or "ICE"). In one embodiment, engine 114 can comprise a gas engine, a diesel engine, or similar. In one embodiment, engine 114 can comprise an exhaust system 115 capable of releasing exhaust from engine 114 as is common in the art.

[0035] In one embodiment, water electrolyzer 100 can comprise a positive terminal 116 and a negative terminal 118. In one embodiment, positive terminal 116 and negative terminal 118 are capable of receiving a wire carrying a corresponding charge, as is well-known in the art. In one embodiment, a positive current 117 can be attached to positive terminal 116 and a negative current 119 can be attached to negative terminal 118. In one embodiment, PWM 104 can provide positive current 117 and negative current 119 to water electrolyzer 100. In one embodiment, PWM 104 can comprise a source of pulse width modulated direct current electricity. In one embodiment, PWM 104 is capable of altering a frequency and a pulse width modulation of a current in order to keep an average current at a set point independent of a supply voltage.

[0036] In one embodiment, water electrolyzer 100 can comprise a sensor 120 and a controller 122. In one embodiment, sensor 120 is capable of measuring an internal temperature of water electrolyzer 100 and reporting said internal measurement to controller 122. In one embodiment, controller 122 can send an off signal when said internal measurement reaches a threshold temperature. In one embodiment, said "off signal" from controller 122 can cause current from battery 102 to stop flowing toward water electrolyzer 100. In one embodiment, controller 122 can engage cooling system 106 to further regulate said internal temperature of said water electrolyzer 100.

[0037] In one embodiment, water electrolyzer 100 can receive a source of direct current. In one embodiment, said source of direct current can comprise a power output from an alternator. In one embodiment, said alternator can be attached to an engine or generator. In another embodiment, said source of direct current can comprise battery 102. In one embodiment, water electrolyzer 100 can receive a pulsed direct circuit from battery 102. In one embodiment, said pulsed direct circuit can pass through a relay switch 124. In one embodiment, relay switch 124 can control said pulsed direct circuit and thereby trigger an on-off operation of water electrolyzer 100. In one embodiment, said pulsed direct circuit can be protected by a fuse 126. In one embodiment, fuse 126 can prevent an over leap of electric current and thereby prevent

damage to PWM 104. In one embodiment, PWM 104 can comprise an advanced (brand) pulse width modulator unit. In one embodiment, fuse 126 can comprise a 15 amperage fuse. In one embodiment, water electrolyzer 100 can operate on 5-15 amps.

[0038] In one embodiment, PWM 104 can comprise a "Pulse Width Modulator". In one embodiment, PWM 104 can comprise an electronic device between battery 102 and water electrolyzer 100 capable of providing a pulse width modulated direct current electricity. In one embodiment, said pulse width modulated direct current electricity can comprise a current comprising constant pulse width. In one embodiment, battery 102 and PWM 104 can provide a source of pulse width modulated direct current electricity.

[0039] In one embodiment, battery 102 can comprise a positive terminal 103a and a negative terminal 103b. In one embodiment, PWM 104 can comprise a positive input terminal 105a, a negative input terminal 105b, a positive output terminal 105c, and a negative output terminal 105d. In one embodiment, negative terminal 103b of battery 102 can be attached to negative input terminal 105b of PWM 104. In one embodiment, positive terminal 103a can be attached to positive input terminal 105a. The PWM 104 receives a positive and negative charged direct current from battery 102. In one embodiment, battery 102 can comprise a 12 volt source. In one embodiment, PWM 104 can alter a frequency and a pulse width in said pulsed direct circuit. In one embodiment, PWM 104 can keep an average current at a set point, independent of the supply voltage or load. Internal components of PWM 104 can include resistors, capacitors, transistors and other components. In one embodiment, said frequency is set between 50 Hertz to 80 Hertz. In one embodiment, said pulsed direct circuit is conducted by wire to water electrolyzer 100. In one embodiment, positive output terminal 105c of PWM 104 can attach to positive terminal 116.

[0040] In one embodiment, negative output terminal 105d can attach to negative terminal 118. In one embodiment, said pulsed direct circuit can comprise battery 102 connected to PWM 104, and PWM 104 connected to water electrolyzer 100.

[0041] In one embodiment, water electrolyzer 100 can produce gases 110. In one embodiment, gases 110 are fed through feed line 108 to air intake system 112 of engine 114. In one embodiment, gases 110 can comprise a mixture of hydrogen, oxygen and other elements. In one embodiment, gases 110 can comprise oxyhydrogen (also known as "hydroxyl"), as discussed supra.

[0042] In many embodiments, modern internal combustion engines have a fuel management system controlled by many sensors that relay information to an engine computer. Said fuel management systems can control operational parameters, such as an air-to-fuel ratio, of engine 114. Said fuel management systems can comprise a mass air flow sensor 128 and an oxygen sensor 130. In one embodiment, mass air flow sensor 128 is connected to a micro electric device 132. In one embodiment, oxygen sensor 130 is connected to a micro electric device 132. In one embodiment, items 128-134 can be connected to an engine computer unit 136, as discussed infra.

[0043] In one embodiment, said air-to-fuel ratio can comprise a mass ratio of air and fuel present in engine 114. In one embodiment, said air-to-fuel ratio can comprise a stoichiometric mixture of 14.7 to 1. In one embodiment, engine 114 can control a volume of air coming into air intake 112. The term "air" refers to the mixture of gases that surround engine 114.

Generally, air can comprise 79% Nitrogen and 21% Oxygen. Traditionally, air is provided to engine 114 through air intake 112, and engine 114 burns hydrocarbon fuel within air.

[0044] In one embodiment, engine 114 can regulate said stoichiometric mixture in order to balance for optimum efficiencies and performance. For example, in one embodiment, micro electric device 132 can monitor mass air flow sensor 128 to ensure a proper amount of air is provided to air intake 112 to ensure engine 114 has said stoichiometric mixture. In one embodiment, said stoichiometric mixture is the working point that modern management systems use to control fuel usage. For example, in one embodiment, Otto cycle engines (spark plug non diesel) can comprise said stoichiometric mixture of air-to-fuel ratio is 14.7 to 1. In one embodiment, a mixture less than 14.7 to 1 comprises a "rich mixture" and a mixture greater than 14.7 to 1 comprises a "lean mixture."

[0045] In one embodiment, adding said gases 110 into air intake system 112, greater efficiencies of combustion can be achieved by engine 114. In one embodiment, adding gases 110 (such as oxyhydrogen) to air intake 112 said stoichiometric mixture can be altered. In one embodiment, adding gases 110 to air intake 112 can increase said air-to-fuel ratio and thereby create said lean mixture. When the gas mixture is added to an air intake system of an internal combustion engine, a combustion efficiency can be increased resulting in reduced usage of hydrocarbon fuel and reduced exhaust emissions of greenhouse gases.

[0046] Changing said stoichiometric mixture can cause issues within many embodiments of engine 114. In many embodiments, engine 114 can comprise an engine computer unit 136 comprising a data connection with micro electric device 132 and/or micro electric sensor controller 134. In one embodiment, engine computer unit 136 can control said stoichiometric mixture by monitoring mass air flow sensor 128 and/or oxygen sensor 130 and altering a volume of air coming into air intake 112. In one embodiment, oxygen sensor 130 can measure an amount of oxygen (and other chemicals) present in exhaust system 115. In one embodiment, oxygen sensor 130 can produce a signal 138 between 0.0-1.0 volts representing a range of oxygen output readings. In one embodiment, where said stoichiometric mixture is optimum, oxygen sensor 130 can produce signal 138 of 500 millivolts. In one embodiment, where signal 138 falls below 500 millivolts, said stoichiometric mixture can be interpreted as being said lean mixture. Likewise, in one embodiment, where signal 138 reads above 500 millivolts, said stoichiometric mixture can be interpreted as being said rich mixture. In one embodiment, where oxygen sensor 130 reads as said lean mixture, engine computer unit 136 can be programmed to react by increasing a fuel injection process within said engine 114 in order to said stoichiometric mixture. In so doing, an increase in said fuel injection process can cause engine 114 to use more fuel (such as gasoline and/or diesel) and thereby drop in efficiency. A problem arises, therefore, where introducing gases 110 into engine 114 can cause oxygen sensor 130 to read said lean mixture.

[0047] In one embodiment, said water electrolyzer system and water electrolysis method for internal combustion engines can comprise modifying one or more signals from oxygen sensor 130 and/or mass air flow sensor 128 to indicate a balanced stoichiometric mixture in exhaust system 115 when an original signal indicates a lean mixture. That is, in one embodiment, said water electrolyzer system and water electrolysis method for internal combustion engines can comprise

ensuring that said engine 114 does not run inefficiently when gases 110 are added into air intake 112. Accordingly, in one embodiment, signal 138 from oxygen sensor 130 can be modified by installing an electronic fuel injection enhancer 140 between oxygen sensor 130 and engine computer unit 136. In one embodiment, electronic fuel injection enhancer 140 can comprise a digital device capable of modifying said signal 138 such that engine computer unit 136 does not alter said fuel injection process. For example, in one embodiment, electronic fuel injection enhancer 140 can reduce signal 138 from 500 millivolts to 350 millivolts. In one embodiment, reducing signal 138 can cause engine 114 to run in said lean mixture which can accommodate the introduction of gases 110 (such as oxyhydrogen) into engine 114.

[0048] FIG. 2 illustrates a perspective front overview of water electrolyzer 100 with cooling system 106. In one embodiment, water electrolyzer 100 can comprise a nonconductive material.

[0049] In one embodiment, said nonconductive material can comprise seamless polyethylene construction. In one embodiment, water electrolyzer 100 can comprise a casing 200 and a hand hole cover 202. In one embodiment, casing 200 can comprise an air sealed housing releaseably sealed with hand hole cover 202. Water electrolyzer 100 can comprise a top 204, a side portion 206 and a bottom 208.

[0050] In one embodiment, hand hole cover 202 can comprise a removable gasket capable of attaching to an aperture 210 in top 204 of water electrolyzer 100. In one embodiment, hand hole cover 202 can be removed from water electrolyzer 100 to expose an interior portion 212 (illustrated infra) of water electrolyzer 100. In one embodiment, interior portion 212 can be accessed through aperture 210 when hand hole cover 202 is removed. In one embodiment, hand hole cover 202 can comprise a handle 214. In one embodiment, hand hole cover 202 can attach to casing 200 by a threading by screwing hand hole cover 202 into casing 200 or by tension by wedging hand hole cover 202 into casing 200.

[0051] In one embodiment, hand hole cover 202 can comprise a cap assembly 218. In one embodiment, cap assembly 218 can be in fluid connection with interior portion 212 of water electrolyzer 100. In one embodiment, cap assembly 218 can comprise a cap 219. In one embodiment, cap 219 can close cap assembly 218 and thereby keep said fluid connection with interior portion 212 closed. In one embodiment, hand hole cover 202 can comprise an outlet fitting 220. In one embodiment, outlet fitting 220 can be in fluid connection with interior portion 212 of gases 110. In one embodiment, feed line 108 can connect to outlet fitting 220. In one embodiment, water electrolyzer 100, air intake system 112 and engine 114 can be in fluid connection through outlet fitting 220 and feed line 108.

[0052] In one embodiment, water electrolyzer 100 can comprise a first fitting 222 and a second fitting 224. In one embodiment, cooling system 106 can comprise a first tubing 226 and a second tubing 228. In one embodiment, second fitting 224 can be in said side portion 206 near bottom 208 of water electrolyzer 100. In one embodiment, first fitting 222 can be in top 204 of water electrolyzer 100. In one embodiment, first tubing 226 can attach to first fitting 222. In one embodiment, second tubing 228 can attach to second fitting 224. In one embodiment, cooling system 106 can comprise a closed loop system capable of circulating a portion of reservoir of water 302 from within interior portion 212 through cooling system 106 and back into interior portion 212. In one

embodiment, water can pass through second fitting 224, through second tubing 228, through cooling system 106, through first tubing 226 and into first fitting 222. In one embodiment, a domed liquid level sight (not illustrated) and sensor 120 can be provided for maintenance of water electrolyzer 100.

[0053] FIGS. 3A and 3B illustrate a perspective side cross-section view and an elevated side cross-section view of water electrolyzer 100 showing interior portion 212 and one or more electrode cells 300. In one embodiment, electrode cells 300 can be installed within a reservoir of water 302 within water electrolyzer 100. In one embodiment, reservoir of water 302 can comprise a water surface 304. In one embodiment, reservoir of water 302 can comprise an electrolyte 306. In one embodiment, interior portion 212 can comprise a headspace 308 above water surface 304. In one embodiment, gases 110 can collect in headspace 308. In one embodiment, reservoir of water 302 can comprise a height 309a and headspace 308 can comprise a height 309b. In one embodiment, height 309a can comprise 80% of interior portion 212.

[0054] In one embodiment, an amount of hydrogen and oxygen gas produced by water electrolyzer 100 can be proportionally correlated to the capacitance of electrolyte 306. In one embodiment, electrolyte 306 can comprise a distilled water. In one embodiment, distilled water comprises a proper material selection for electrolyte 306 since distilled water can be capable of controlling an electrical current.

[0055] In one embodiment, hand hole cover 202 can be removed from water electrolyzer 100 to access electrode cells 300. In one embodiment, electrode cells 300 can be installed by removing hand hole cover 202, inserting electrode cells 300 through aperture 210 and into water electrolyzer 100, attaching electrode cells 300 to a bottom portion 310 of interior portion 212 of water electrolyzer 100.

[0056] In one embodiment, cap assembly 218 can be opened to remove or add water to reservoir of water 302, electrolyte 306, gases 110 or other materials as necessary. In one embodiment, gases 110 can travel through outlet fitting 220 and feed line 108 to air intake system 112, as discussed supra.

[0057] In one embodiment, a byproduct of the electrolysis process can comprise an excessive increase of temperature within water electrolyzer 100. In one embodiment, said water electrolyzer system and water electrolysis method for internal combustion engines can require said temperature of reservoir of water 302 to remain within a temperature control range between 42-150 degrees Fahrenheit. In one embodiment, cooling system 106 can be used to maintain said temperature control range by circulating a portion of reservoir of water 302 through cooling system 106. In one embodiment, cooling system 106 can comprise a recirculation pump, radiator, and cooling fan. In one embodiment, an additional reservoir can be used for descaling solution for cleaning said electrode cells 300. In one embodiment, cooling system 106 can communicate with sensor 120 and controller 122 to regulate said temperature control range by reporting a temperature reading from within water electrolyzer 100 to cooling system 106 and engaging cooling system 106 to regulate said temperature control range. In one embodiment, controller 122 can shut off relay switch 124 if temperature exceeds said temperature control range.

[0058] In one embodiment, water electrolyzer 100 can comprise one or more lines 311 comprising one or more positive lines 312 and one or more negative lines 314. In one

embodiment, positive lines 312 can connect positive terminal 116 to a portion of electrode cells 300, and negative lines 314 can connect negative terminal 118 to a portion of electrode cells 300, as discussed *infra*. In one embodiment, positive lines 312 and negative lines 314 can connect to cell 300 in series or in parallel configurations. In one embodiment, positive lines 312 and negative lines 314 can comprise a stranded copper wire. In one embodiment, positive lines 312 and negative lines 314 can comprise a 12 gauge wire.

[0059] In one embodiment, positive terminal 116 and negative terminal 118 can each comprise a portion which extends outside of water electrolyzer 100 and a portion which extends into said interior portion 212 of water electrolyzer 100. In one embodiment, positive current 117 and negative current 119 can each connect to said portion which extends outside of water electrolyzer 100 of positive terminal 116 and negative terminal 118, respectively. In one embodiment, positive lines 312 and negative lines 314 can each connect to said portion which extends into said interior portion 212 of water electrolyzer 100 of positive terminal 116 and negative terminal 118, respectively.

[0060] In one embodiment, water electrolyzer 100 is capable of regulating a water temperature of reservoir of water 302. In one embodiment, where said water temperature gets too hot, water electrolyzer 100 can produce a steam. In one embodiment, said steam is not a preferred byproduct of water electrolyzer 100. In one embodiment, controller 122 can engage said cooling system 106 to cool said reservoir of water 302. In one embodiment, controller 122 can engage cooling system 106 when sensor 120 measures said water temperature above a threshold level.

[0061] In one embodiment, electrode cells 300 can be separated by one or more blocks 318. In one embodiment, blocks 318 can comprise a nonconductive material (such as nylon). In one embodiment, blocks 318 can support electrode cells 300.

[0062] FIGS. 4A, 4B and 4C illustrate a perspective front view, perspective rear view and elevated top view of electrode cells 300. As shown in FIGS. 3A-4C, electrode cells 300 can comprise three electrode cells; however, electrode cells 300 there is no theoretical limit to the number of electrode cells 300 that can be used within water electrolyzer 100. For purposes of this disclosure, three are used to illustrate use and functionality of water electrolyzer 100. In one embodiment, electrode cells 300 can comprise a first electrode cell 300a, a second electrode cell 300b and a third electrode cell 300c. Each of electrode cells 300 can comprise a front portion 401a and a back portion 401b. In one embodiment, each of electrode cells 300 can comprise one or more spacers 402, a first plate 404 and a second plate 406. In one embodiment, first plate 404 and second plate 406 can be attached on opposing sides of spacer 402. In one embodiment, first plate 404 and second plate 406 can be parallel to one another. In one embodiment, spacers 402 can comprise a non-conductive material. In one embodiment, spacers 402 can comprise a thickness 407. In one embodiment, thickness 407 can comprise an eighth of an inch ($\frac{1}{8}$ ""). In one embodiment, thickness 407 can comprise a sixteenth of an inch ($\frac{1}{16}$ ""). In one embodiment, as thickness 407 is increased, a larger amount of current is necessary for cell 300 to function. However, in one embodiment, as thickness 407 is decreased said electrodes of cell 300 are more likely to touch and thereby short cell 300.

Thus, in one embodiment, thickness 407 can be large enough to facilitate a minimal amount of current without said electrodes touching.

[0063] In one embodiment, a plurality of cells 300 can be arranged in with a spacing 408 between them. In one embodiment, spacing 408 can comprise one inch (1").

[0064] FIG. 5A illustrates a perspective exploded side view of one of electrode cells 300. Spacers 402 can comprise a spacer 402a, a spacer 402b, a spacer 402c and a spacer 402d. In one embodiment, spacers 402 can be arranged around one or more corner portions of electrode cells 300. In one embodiment, spacers 402 can comprise a plurality of spacers 402 capable of holding first plate 404 and second plate 406 apart. In one embodiment, first plate 404 and second plate 406 can attach to spacers 402 with an adhesive. In another embodiment, first plate 404 and second plate 406 can be held together and around spacer 402 by wrapping a nonconductive strap around electrode cells 300. In one embodiment, positive lines 312 can attach to first plate 404 by clipping a portion of positive lines 312 to first plate 404 with a first clip 502. Likewise, in one embodiment, negative lines 314 can attach to second plate 406 by clipping a portion of negative lines 314 to second plate 406 with a second clip 504. In one embodiment, first clip 502 can comprise a material similar to first plate 404. Likewise, in one embodiment, second clip 504 can comprise a material similar to second plate 406.

[0065] FIG. 5B illustrates a perspective exploded side view of one of electrode cells 300 with an epoxy coating 506 on first clip 502 and second clip 504. In one embodiment, epoxy coating 506 can comprise a sealant. In one embodiment, epoxy coating 506 can comprise a material capable of preventing electric current contact with electrolyte 306. In one embodiment, a first portion of epoxy coating 506 coats a portion of positive lines 312 at first plate 404. In one embodiment, a second portion of epoxy coating 506 coats a portion of negative lines 314 at second plate 406.

[0066] In one embodiment, first clip 502 and second clip 504 can each be covered with epoxy coating 506 to prevent current from flowing through first clip 502 or second clip 504 between first plate 404 and second plate 406. In one embodiment, epoxy coating 506 can comprise a waterproof epoxy sealant. In one embodiment, said waterproof epoxy sealant can prevent an electrical contact with reservoir of water 302 or electrolyte 306.

[0067] In one embodiment, first plate 404 can comprise a positive charge. In one embodiment, first plate 404 can comprise a cathode. In one embodiment, second plate 406 can comprise a negative charge. In one embodiment, second plate 406 can comprise an anode. In one embodiment, first plate 404 can comprise a metal plate. In one embodiment, first plate 404 said metal plate can comprise titanium (Ti). In one embodiment, first plate 404 said metal plate can comprise a material chosen from the refractory group consisting of Ti, V, Cr, Zr, Nb, Mo, Hf and Ta and combinations thereof. In one embodiment, said metal plate can comprise a coating. In one embodiment, said coating can comprise a ruthenium (Ru) material. In one embodiment, said coating can comprise a material from the group consisting of Ru, Rh, Pd, Os, Ir, Pt, Ag, Au and combinations thereof. In one embodiment, said coating can comprise a noble metal. In one embodiment, second plate 406 can comprise a plate consisting of either graphite material or stainless steel. In one embodiment, first plate 404 and second plate 406 can be arranged in parallel with said spacers 402 between one another.

[0068] Various changes in the details of the illustrated operational methods are possible without departing from the scope of the following claims. Some embodiments may combine the activities described herein as being separate steps. Similarly, one or more of the described steps may be omitted, depending upon the specific operational environment the method is being implemented in. It is to be understood that the above description is intended to be illustrative, and not restrictive. For example, the above-described embodiments may be used in combination with each other. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. In the appended claims, the terms “including” and “in which” are used as the plain-English equivalents of the respective terms “comprising” and “wherein.”

1. A water electrolyzer comprising:

a casing, a reservoir of water, one or more electrode cells, a source of pulse width modulated direct current electricity, a positive terminal, a negative terminal, and a cooling system; wherein,
 said casing holds said reservoir of water and said one or more cells,
 said electrode cells are submerged in said reservoir of water,
 said reservoir of water comprises an electrolyte,
 said source of pulse width modulated direct current electricity comprises a positive current and a negative current,
 said source of pulse width modulated direct current electricity attaches to said water electrolyzer by attaching said positive current to said positive terminal and said negative current to said negative terminal of said water electrolyzer,
 said electrode cells each comprise a cathode and an anode,
 said cathode comprises a positive charge,
 said cathode comprises a titanium (Ti) metal plate comprising a ruthenium (Ru) coating,
 said cathode and said anode are arranged parallel to one another with one or more spacers between them,
 said one or more spacers are nonconductive,
 said positive terminal of said water electrolyzer attaches to said cathodes of said electrode cells with one or more positive lines,
 said negative terminal of said water electrolyzer attaches to said anodes of said electrode cells with one or more negative lines,
 said cooling system is capable of cooling said reservoir of water,
 said water electrolyzer produces one or more gases,
 said water electrolyzer is in fluid connection with an engine,
 said water electrolyzer is capable of delivering said gases to said engine, and
 an inlet and an outlet in said casing; further wherein,
 a portion of said reservoir of water is capable of circulating through said cooling system; and,
 said cooling system comprises a circulation pump, heat exchanger and a cooling fan.

2. A water electrolyzer comprising:

a casing, a reservoir of water, one or more electrode cells, a source of pulse width modulated direct current electricity, a positive terminal, a negative terminal, and a cooling system; wherein,
 said casing holds said reservoir of water and said one or more cells,
 said electrode cells are submerged in said reservoir of water,
 said source of pulse width modulated direct current electricity comprises a positive current and a negative current,
 said source of pulse width modulated direct current electricity attaches to said water electrolyzer by attaching said positive current to said positive terminal and said negative current to said negative terminal of said water electrolyzer,
 said electrode cells each comprise a cathode and an anode,
 said cathode and said anode comprise different materials,
 said positive terminal of said water electrolyzer attaches to said cathodes of said electrode cells with one or more positive lines,
 said negative terminal of said water electrolyzer attaches to said anodes of said electrode cells with one or more negative lines,
 said cooling system is capable of cooling said reservoir of water,
 said water electrolyzer produces one or more gases,
 said water electrolyzer is in fluid connection with an engine, and
 said water electrolyzer is capable of delivering said gases to said engine.

3. The water electrolyzer of claim 2 wherein

said source of pulse width modulated direct current electricity comprises a positive output terminal and negative output terminal of a pulse width modulator; wherein said pulse width modulator is attached to a source of direct current.

4. The water electrolyzer of claim 3 wherein said source of direct current can comprise a battery.

5. The water electrolyzer of claim 2 wherein

said water electrolyzer comprises a casing and said casing comprises a nonconductive airtight vessel.

6. The water electrolyzer of claim 2 further comprising an inlet and an outlet in said casing; wherein,

a portion of said reservoir of water is capable of circulating through said cooling system; and,
 said cooling system comprises a circulation pump, heat exchanger and a cooling fan.

7. The water electrolyzer of claim 2 further comprising a sensor and a controller; wherein,

said sensor is capable of
 measuring an internal temperature of said water electrolyzer and
 reporting said internal temperature to said controller; and

said controller is capable of
 comparing said internal temperature to a temperature control range and
 cutting off said source of direct current electricity from said water electrolyzer if said internal temperature is outside of said temperature control range.

8. The water electrolyzer of claim 2 wherein said cathode comprises a metal plate having a positive charge, and
said cathode comprises titanium (Ti) material.
9. The water electrolyzer of claim 8 wherein said metal plate comprises a coating and said coating comprises a ruthenium (Ru) material.
10. The water electrolyzer of claim 2 wherein said cathode comprises a metal plate having a positive charge;
said metal plate comprises a material chosen from a refractory group consisting of Ti, V, Cr, Zr, Nb, Mo, Hf and Ta and combinations thereof; and
said metal plate comprises a coating comprising a material from a group consisting of Ru, Rh, Pd, Os, Ir, Pt, Ag, Au and combinations thereof
11. The water electrolyzer of claim 2 wherein said anode comprises a plate comprising a material chosen from a group consisting of graphite and stainless steel.
12. The water electrolyzer of claim 2 further comprising a sealant; wherein,
said sealant is capable of preventing electric current contact with electrolyte;
a first portion of said sealant coats said positive lines at said positive terminal of said electrode cells; and
a second portion of said sealant coats said negative lines at said negative terminal said electrode cells.
13. The water electrolyzer of claim 12 wherein said sealant comprises an epoxy coating.
14. The water electrolyzer of claim 2 further comprising one or more spacers; wherein,
said cathode and said anode are arranged parallel to one another with said spacers between them, and
said spacers are nonconductive.
15. The water electrolyzer of claim 2 wherein said electrode cells comprise one or more cells arranged parallel to one another and within said water electrolyzer.
16. The water electrolyzer of claim 2 wherein said reservoir of water comprises an electrolyte.
17. The water electrolyzer of claim 16 wherein said electrolyte comprises a distilled water.
18. A water electrolysis method comprising:
submerging one or more electrode cells in a reservoir of water within a water electrolyzer;
applying a source of pulse width modulated direct current electricity to said electrode cells;
generating one or more gases within said water electrolyzer;
attaching said water electrolyzer to an engine with a fluid connection;
feeding said gases from said water electrolyzer into said engine; and, regulating a temperature of said reservoir of water with a cooling system; wherein,
said water electrolyzer comprises a casing,
said casing comprises an airtight vessel,
said water electrolyzer comprises a positive terminal and a negative terminal,
said reservoir of water comprises an electrolyte,
said source of pulse width modulated direct current electricity comprises a positive current and a negative current,
said source of pulse width modulated direct current electricity attaches to said water electrolyzer by attaching said positive current to said positive terminal and said negative current to said negative terminal of said water electrolyzer,
said electrode cells each comprise a cathode and an anode,
said positive terminal of said water electrolyzer attaches to said cathodes of said electrode cells with one or more positive lines,
said negative terminal of said water electrolyzer attaches to said anodes of said electrode cells with one or more negative lines,
said cathode and said anode comprise different materials,
said cathode and said anode are held apart by one or more spacers, and
said spacers comprise a nonconductive material.
19. The water electrolysis method of claim 18 wherein said source of pulse width modulated direct current electricity comprises a positive output terminal and negative output terminal of a pulse width modulator and said pulse width modulator is attached to a source of direct current.
20. The water electrolysis method of claim 18 further comprising:
modifying one or more signals from an oxygen sensor of said engine to indicate a balanced stoichiometric mixture in an exhaust system of said engine when an original signal indicates a lean mixture.

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